power for good may be in proportion to these great resources is the prayer of thousands of alumni, whose pride in its past is their hope for its future.

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AMERICAN SOCIETY OF ZOOLOGISTS. II.

An Experimental Study of the Spawning Behavior of Lampetra wilderi: JACOB REIGHARD, University of Michigan.

An attempt was made to extend Gage's excellent account of the spawning behavior of the brook lamprey, as given in the 'Wilder Quarter Century' book. Space does not permit more than a statement of results, which were obtained under the auspices of the U. S. Fish Commission:

1. Fish were numbered and a record kept of their movements and the behavior of fish removed from the nest and then released was observed, but *no constant relation was found between individual* fish and individual nests.

2. The *location of nests is determined* not by the form or character of the bottom, but by the existence beneath or in the midst of the running water of small masses of water at rest, such as occur in depressions of the bottom or behind or in front of obstructions in the stream. Small glass plates set on edge across the stream on a perfectly level bottom have such inert masses of water above and below them and, although the plates are invisible, the lampreys build nests above and below them, and this on any sort of bottom in which there are stones large enough to serve them for attachment.

3. *Sex recognition* appears to be a reaction of the male to a reaction of the female. Males, females with eggs and spent females were marked so as to be readily distinguishable. Attached males when seized by other males at once release their hold and the two fish separate. Spent females seized when attached behave like males. Females containing eggs, if seized by males while attached, retain their hold and begin at once to 'shake.' The male reacts to this movement by throwing his tail in a loop about the body of the female and then 'shaking' with her. The shaking consists in a rapid vibration of all the body behind the branchial region.

4. The loop formed by the tail of the male is always thrown accurately into the notch between the first and second dorsals of the female. In the female at the breeding season, but not in the male, the second dorsal is œdematous and is believed to serve as a support for the tail of the male during spawning. The small anal fin found in the breeding female, but not in the male, may have the same function.

Some Experiments on the Growth of Oysters: OTTO C. GLASER, Johns Hopkins University. (Introduced by Caswell Grave.)

The occurrence of elongated oysters on the edges of marshes and reefs in waters supporting profitable beds is a well-known but puzzling fact to the culturalist who sees such different results under similar conditions.

Among the explanations given by other workers, excessive crowding seemed to the author to be the only one borne out by his observations, but to test this view more carefully a number of experiments were made.

In one, young normal oysters were subjected by imbedding in cement to lateral pressure, and exhibited after thirty days a slight elongation, and the scolloped anterior edges common in elongated oysters.

In another experiment, to find if oysters liberated from an oppressive environment would change in shape under other conditions, it was discovered that, after forty-

eight days of improved surroundings, the relation between width and length changed from fifty-three per cent. to sixty-six per cent., the width of normal oysters of the same age being seventy-nine per cent. of the length.

A third experiment, to find the limits to the recuperative power, revealed the fact that young oysters take advantage of improved conditions more rapidly than old ones. The youngest oysters in this experiment changed in sixty days in the relation of width to length from fifty per cent. to sixty-eight per cent., whereas the oldest changed only from forty-one per cent. to forty-seven. The recuperative power of the younger ones was three times that of their seniors.

These experiments show that crowding alone explains the elongation; that young elongated oysters can with profit be transplanted to artificial beds, where, under favorable conditions, they can grow to a normal maturity and become marketable.

These experiments were conducted by the North Carolina Geological Survey in cooperation with the U. S. Fish Commission Laboratory at Beaufort.

Growth of Lamprey Embryos in Nature: S. H. Gage, Cornell University. (Read by title.)

Some Points in the Life History of the Human Warble Fly: H. B. Ward, University of Nebraska.

Movements of the Cerebro-spinal Fluid in Cryptobranchus: J. B. Johnston, West Virginia University.

The cerebro-spinal fluid of *Cryptobranchus* normally contains a considerable number of red blood corpuscles which serve as a convenient means of demonstrating the course of flow of the fluid when the brain ventricles are opened, the animal being under the influence of chloretone.

There is a general current which flows backward on the floor and the lower part of the side walls of the brain, and forward along the roof and the upper part of the side walls. Subordinate circuits, each more or less complete in itself, are present in the hind-brain, in the mid- and 'tween-brains and in the fore-brain. This is especially noticeable in the mid- and 'tween-brains, where there is a distinct whirlpool of corpuscles on the lateral wall. Also on the side wall of the medulla oblongata are several small whirlpools between the upper and lower currents of the main circuit. In the lobi inferiores the directions of the main circuit are reversed, so that the current flows backward on the roof of the lobes and saccus vasculosus and forward on the floor. It is possible that the three sections of the current are related in some way to the three vascular plexuses of the brain, but it is more probable that they are due to the two chief isthmuses by which the ventricles are divided into three parts.

The corpuscles have the appearance of being driven by cilia. The fact that the current is kept up after the brain is opened, and that the corpuscles are driven against the force of gravity when the brain is tilted, and the formation of whirlpools are scarcely to be explained in any other way. No such long flagella as are seen in the brain of *Acipenser,* nor any special ciliated tracts such as have been described for other forms, have been found, but apparently the whole floor and part of the side walls of the brain ventricles are covered with very fine cilia.

On the Negative and Positive Phototropism of the Earthworm Allolobophora fœtida (Sav.) *as Determined by Light of Different Intensities:* G. P. Adams. (Presented by G. H. Parker.)

Allolobophora fœtida is negatively phototropic toward light from electric incan-

descent lamps varying in intensity from 192 candle-meters to .012 candle-meter; the percentages of negative head movements referable to light of different intensities are as follows: 41.5 per cent. (192 cm.), 41.5 per cent. (90 cm.), 59 per cent. (48 cm.), 45 per cent. (31 cm.), 45.5 per cent. (12 cm.), 38.5 per cent. (5 cm.), 24.5 per cent. (1 cm.), 14 per cent. (.128 cm.), 12 per cent. (.050 cm.), 5 per cent. (.020 cm.), and 3 per cent. (.012 cm.). *A. fœtida* is positively phototropic toward an electric incandescent light of .001 candle-meter intensity. Earthworms retreat into their burrows during daytime because of their negative phototropism. They emerge at night not so much because of darkness, but because of their positive phototropism for faint light.

The Collembola Fauna of Cold Spring Harbor Beach: C. B. DAVENPORT, University of Chicago.

The apparently lifeless surface of the between-tide zone of this sandy beach supports a vast host of minute insects belonging to the family Poduridæ. These animals crawl out to the surface after the retreat of the tide and return again into the sand as the tide rises. The period which they spend on the surface is spent in ceaseless activity, and the direction of all this complex movement is determined by the resultant of the physical agents by which they are surrounded. They are geotactic, hydrotactic, rheotactic, thigmotactic and phototactic in the highest degree. This extreme sensitiveness of organisms closely related to the ancestors of insects is suggestive in view of the complex nervous mechanism and reactions attained by their most highly developed descendants.

The Function of the Pearl Organs of the Cyprinidæ: JACOB REIGHARD, University of Michigan.

Pearl organs are found in the breeding males of many fish, but only rarely in the females. The breeding behavior of three forms was studied, *Campostoma anomalum, Rhinichthys atronasus* and *Semotilus atromaculatus.*

The organs in all these cases are spines and in each case they were found to have a mechanical function. They are used in *Campostoma* in building the nest, in the battles of the males and in holding the females during the act of spawning. In *Semotilus* and *Rhinichthys* they are used in holding the spawning female. The method of holding the females is different in each of these three cases, but in each case the distribution of the pearl organs corresponds to this mechanical use.

Phototaxis in Volvox: S. J. HOLMES, University of Michigan.

In light of weak or moderate intensity *Volvox* is positively phototactic and orients itself very accurately to the direction of the rays. In swimming towards the light the anterior end of the organism is directed forwards, the body rotates on its longer axis, and deviates remarkably little from a perfectly straight course. In very strong light *Volvox* becomes negatively phototactic, swimming away from the light in very nearly a straight line. The grouping of *Volvox* in places of a certain intensity of illumination is a natural consequence of the fact that this organism is positively phototactic in weak light and negatively so in strong light. In very dim light *Volvox* shows no pronounced phototaxis, and either lies quiet or rolls about in a slow and irregular manner. In moving towards the source of light the rate of locomotion, within certain limits, increases with increase in the intensity of illumination, but, as the optimum is approached, the speed becomes gradually less. In swimming away from strong light the speed is likewise lessened as the optimum

is approached from the other side. It is difficult to explain the orientation of *Volvox* on the theory that it is brought about by differences in the intensity of illumination on the two sides of the organism. According to this view, we should expect that as *Volvox* passes from weak into stronger light its rate of speed would be decreased, but this does not occur. The explanation of orientation in this form is not so simple a matter as it might seem.

The Blood Flow and the Structure of the Vessels in the Earthworm: J. B. Johnston and Sarah W. Johnson.

We have previously reported the results of an experimental study of the course of the blood flow in *Lumbricus,* which showed that the circulation in this worm is not segmental, but strictly systemic. This view of the circulation opened two lines of further inquiry: What happens when the hearts are removed from the circulation by cutting off the head segments of the worm; and what is there in the structure of the blood vessels to determine the course of blood flow? A series of regeneration experiments and the study of the histology of the blood vessels have given striking confirmation of our previous conclusions.

1. In all animals from which the head segments were removed there was an enormous collection of blood in the anterior end of the worm, including the regenerated segments. Such a condition would probably not be brought about if there were a segmental circulation in the normal worm. Usually all circular vessels were crowded, but the intestinal vessels and spaces were more distended than the parietal vessels.

2. The dorsal vessel and all the vessels connected with it are provided with valves which determine the direction of the blood flow. In the dorsal vessel at the level of each septum is a pair of large, thick, flap-like valves, one attached to either lateral wall of the vessel. These valves open forward and are closed at the time of each contraction-wave. The parietal, dorso-intestinal and dorso-typhlosolar vessels are each provided with similar valves, so placed in the mouth of each vessel that the blood can flow freely into the dorsal vessel, while each vessel is closed by its valves in advance of the contraction-wave of the dorsal vessel. No valves have been found in any other vessels, but these are enough to direct the blood flow.

3. The walls of the vessels are made up of three coats: (*a*) A layer of extremely thin, flat, endothelial cells; (*b*) a connective tissue membrane containing longitudinal fibers, probably muscular; (*c*) a layer of circular muscle fibers. The valves are masses of cells connected with the connective tissue layer. The circular muscle layer is especially thickened at the valves in the dorsal and parietal vessels, and the contraction of these bands of muscle presses the valves together, completely closing the vessels. A similar mechanism in the intestinal and typhlosolar vessels has not been seen, but the valves are so placed as to open toward the dorsal vessel and to be closed by backward pressure.

On Phyllodistomum americanum n. sp., a parasite in the Urinary Bladder of Amblystoma tigrinum Green, in Minnesota: Henry Leslie Osborn, Hamline University.

This genus, recently founded by Braun,* has been reported from central Europe, eastern Asia and northeastern Africa, from the urinary bladders of fish and amphibia,† but has not hitherto been recognized in this hemisphere. I have found that flukes generically identical with the old world ones,

* 'Ueber Clinostomum,' *Zool. Anzeig.,* XXII., pp. 484–488, 1900.

† Looss, 94, *Distom. Fisch. u. Frosch;* Sturgis, 97, *Zool. Bulletin,* I., p. 57; Odhner, '00, *Cent. F. Bakt. u. Parasit.,* XXXI., pp. 58–69.

but specifically distinct, occur in the urinary bladder of a salamander, *Amblystoma tigrinum* Green, which is found frequently in the district near Saint Paul, Minn. The number of the parasites found in a single host is not large (two to ten and this in only six out of twenty-nine salamanders examined). The total length of the largest specimen of the parasite thus far seen is 3.5 mm., its greatest width 1.4 mm. or 40 per cent. of the length. It is thus much narrower than any of the old world forms, *P. patellare* having this ratio, 66 per cent., *P. spatula* (Odhner, '00) 63 per cent. and *P. folium* 48 per cent. One of Odhner's species, *P. unicum*, has a width of 43 per cent. of the length, according to his figures. The testes in the American form are both completely posterior to the ovary, and nearly in line one in front of the other. The testes, ovary and vitellaria are all deeply lobed. This is unlike *P. unicum*, which resembles this species in its proportions, but in which the genital organs are said to be entire or nearly so. The course of the uterus is characteristic: next the ootype there is, first on the left side a loop forward, then one backward and behind the posterior testis, then one in front of this and behind the anterior testis, then another in front of the anterior testis, then crossing to the right side in front of the ovary, first an anterior loop and then a posterior loop. This is unlike either *P. folium* or *P. patellare*. A fuller account of the anatomy of this species is in process of preparation; the name is given in view of its being the first species of the genus to be reported from this country.

On Cryptogonimus chyli, n. g., n. sp., a Trematode from Lake Chautauqua, N. Y., with Novel Type of Ventral Sucker: HENRY LESLIE OSBORN, Hamline University.

A very small distomid fluke (0.5–1.3 mm. in length) of decidedly aberrant structure occurs abundantly in the chyle of the black bass (*Micropterus dolomieu*) of Lake Chautauqua, New York, and in the St. Mary's River near Sault Sainte Marie, Mich. The body is cylindrical, obtusely tapering posteriorly, is covered with broad flat scales and has a large oral sucker. About the front end of the middle third of the body there is, mid-ventrally, a peculiar and unique sheath, with circular lip and sphincter muscle enclosing a chamber in which are located two entirely disconnected ventral suckers, one behind the other, with the genital pore located in the middle line between them and wholly separate from either. There is a pharynx, a very short œsophagus, the intestines reach only to the beginning of the hinder third of the body, there are two conspicuous masses of pigment (but no lenses) on either side of the pharynx, seemingly rudiments of eyes. The excretory pore is terminal, there is a large median bladder in the hinder third of the body, and a large fork from it on each side running forward to the level of the pharynx, forming there a large conspicuous hollow cavity on each side. The spermaries are oblique and near the beginning of the hinder third of the body. The ovary is near the level of the anterior spermary, the uterus passes posteriorly to the extreme end of the body, returns on the opposite side black in color from the multitudes of ova, crosses to the right side and runs to the surface, crossing over the posterior ventral sucker in its course, and joining the ductus ejaculatorius to form a very short muscular genital sinus. The vitellaria consists of a number of distinct follicles in a row laterally in the middle third of the body. A Laurer's canal or seminal receptacle seems to be present in the form of a tube connected with the oviduct near the junction of the yolk ducts, but it lacks a

communication with the exterior. There is a large seminal vesicle, but no sac; prostate cells are present, collected around the passage from the seminal vesicle to the exterior. They are not shut off by a membrane from the surrounding parenchyma. I have not as yet reached any conclusion as to the affinities of this form with the other distomids.

Some Recent Additions to the Marine Fauna of Bermuda: C. L. Bristol, New York University.

Distribution of Fresh-water Fishes in Mexico: S. E. Meek, Field Columbian Museum.

A Comparison of the Plankton of Green Lake and Lake Winnebago: C. D. Marsh, Ripon College.

These lakes represent the two types of deep and shallow lakes. Plankton collections were made upon them regularly for a period of two years and a half. From these collections records were made of the annual distribution of the total plankton and of the principal constituents of the plankton. For comparison a number of other lakes were visited at different periods, but upon them no continuous record was kept. The attempt was, first, to accumulate a certain number of facts in regard to the plankton, and then, second, if possible, determine some of the fundamental principles controlling the distribution of the plankton and its constituents. The distribution of the total plankton was discussed briefly, and then an account was given of the annual distribution of two or three of the more important individuals composing the plankton. Attention was called to certain interesting relations between the occurrence of species and temperature, and then the question of the balance between animal and vegetable organisms was discussed at some length.

A Combined Locker and Laboratory Table: Pierre A. Fish, Laboratory of Comparative Physiology and Pharmacology, N. Y. State Veterinary College, Ithaca, N. Y. (To be published, with illustrations, in *Journal of Applied Microscopy.*)

Specifications.—Both sides of the table are to be exactly alike. Each table will then have four doors, four drawers, each five inches deep in the clear, and eight drawers each three inches deep in the clear.

Exterior of tables and fronts of drawers are to be of selected red oak; drawer guides or slides of oak, maple or cherry; and balance of interior work of poplar.

Each door shall be hung with one pair good brass fast pin butts, and shall be fitted with an 'anti-dial' combination lock. Each table shall be fitted with eight 'standard' No. 7, all steel castors.

Except the top, all exposed work, including drawer fronts, shall be filled with silica paste filler, and shall then be finished with one coat of white shellac and one coat of Johnson's, or equally good, wax. Inside and drawers, except fronts, shall have one coat of orange shellac.

The table in question was designed for laboratory work in physiology and materia medica. The height and also the area of the table top is somewhat greater than ordinary for the reason that, in experimental physiology, it is necessary at times to have considerable apparatus upon the table, and the height is desirable because in some experiments the student can do his work better standing than sitting. The foot rest attached to the tables, in connection with a stool a trifle higher than usual (twenty-four inches), enables the table to be perfectly serviceable and entirely satisfactory for all forms of work at which it is desirable that the student should sit.

The chief advantage of the table, however, is believed to rest upon the fact that a considerable economy of space and con-

venience to the worker is subserved. The floor space covered by the table in many instances is not utilized at all, except for the work done upon the top of the table. Lockers, when necessary, have been built along the walls of the laboratory or in the hallway or in an adjoining room, thus taking up space which might be profitably utilized by wall cases containing specimens, models or general apparatus bearing upon the laboratory course. Students often pass to and fro from table to locker, causing more or less jar and vibration, especially annoying if microscopical work is going on. Such an arrangement is doubly inconvenient. It is annoying to the student to be obliged to go from table to locker. It is also annoying to his fellow workers to have him do so.

The combined lockers and table obviates these disadvantages. Each table contains four lockers, and two students can work at one table and have their apparatus right at hand. Twelve tables will provide lockers for forty-eight students, and twenty-four students can work at the tables at one time.

The table would appear to be useful for biological work in general, although in certain cases a proportionate change in dimensions may be desirable.

The cost of the combined locker-table is less than the total cost of a table and four lockers built separately. In lots of one dozen, the combined locker-table, including a combination lock for each locker, can be built in red oak for fourteen dollars each, or in chestnut for twelve dollars each. The writer has used these tables for nearly two years and has found them satisfactory in every way.

An Acid-proof Table Top: PIERRE A. FISH, Laboratory of Comparative Physiology and Pharmacology, N. Y. State Veterinary College, Ithaca, N. Y.

Three or four years ago the writer saw in a pharmaceutical journal (*Merck's Report*) a formula for a black finish for table tops. The article did not give the author's name nor the original source of the formula, but stated that the method was 'used abroad.' Further acknowledgment can not, therefore, be made. The formula was as follows:

1.

Copper sulphate	1 part.
Potassium chlorate	1 "
Water	8 parts.

Boiled until salts are dissolved.

2.

Aniline hydrochlorate	3 parts.
Water	20 "

Or if more readily procurable:

Aniline	6 "
Hydrochloric acid	9 "
Water	50 "

By the use of a brush two coats of solution No. 1 are applied while hot, the second coat as soon as the first is dry; then two coats of solution No. 2, and the wood allowed to dry thoroughly. Later a coat of raw linseed oil is to be applied, using a cloth instead of a brush in order to get a thinner coat of the oil.

The writer used this method upon some old laboratory tables which had been finished in the usual way, the wood having been filled, oiled and varnished. After scraping off the finish down to the wood the solutions were applied, and the result was very satisfactory.

After some experimentation the formula was modified without materially affecting the cost and apparently increasing the resistance of the wood to the action of strong acids and alkalies. The modified formula follows:

1.

Iron sulphate	4 parts.
Copper sulphate	4 "
Potassium permanganate	8 "
Water	q. s. 100 "

2.

Aniline	12	parts.
Hydrochloric acid	18	"
Water	q. s. 100	"
or		
Aniline hydrochlorate	15	"
Water	q. s. 100	"

Solution 2 has not been changed except to arrange the parts per hundred.

The method of application is the same except that after solution No. 1 has dried, the excess of the solution which has dried upon the surface of the wood is thoroughly rubbed off before the application of solution No. 2. The black color does not appear at once, but usually requires a few hours before becoming ebony black. The linseed oil may be diluted with turpentine without disadvantage, and after a few applications the surface will take on a dull and not displeasing polish. The table tops are easily cleaned by washing with water or suds after a course of work is completed, and the application of another coat of oil puts them in excellent order for another course of work.

Strong acids or alkalies when spilled, if soon wiped off, have scarcely a perceptible effect.

A slate or tile top is expensive not only in its original cost, but also as a destroyer of glassware. Wood tops when painted, oiled or paraffined, have objectionable features, the latter especially in warm weather. Old table tops, after the paint or oil is scraped off down to the wood, take the finish nearly as well as the new wood.

A Useful Light for Biological Laboratories: E. A. Andrews, Johns Hopkins University.

Experiments at the seashore and in this laboratory show that acetylene lamps have some advantages over other artificial lights for use with the microscope when good daylight is not available. These are: less irritating character of the light, greater whiteness, that enables color to be justly judged, and portability. With these is joined an intensity sufficient for use with Zeiss 18-ocular and 2-mm. objective.

The Welsbach light with Eisen's color screens* gives excellent results, but the aniline screens are troublesome, the mantles fragile and a gas supply not everywhere available.

The electric lamps as used by Metcalf† are exceedingly convenient, but less powerful and less white than the acetylene lamp.

Some of the better acetylene bicycle lamps give good results for the individual worker; but, till the market be supplied with a lamp specialized for our purposes, the best lamp for individual and for class use seems to be the acetylene lamp known as the 'Electrolite.' To adapt this to microscopic work we add a 'bobeche' as used for Welsbach lights, made of finely ground imported glass. There is also added an opaque shade, instead of a globe, large enough to restrict the light to the area of the table in use. All the light used passes through the ground glass and is diffused.

For use with high powers and vertical stand the too tall lamp may be placed lower than the work table. On the other hand, for a class using low powers the tall stand will spread the light, so that ten or twelve using Zeiss D and ocular 2 may work around one lamp if the tables are properly placed.

The objection to acetylene lamps is the trouble of attending to them, but in the 'Electrolite' filling and cleaning are not difficult, and with one charge of carbide the lamp may be put out and relighted at any time till more than ten hours of actual burning have passed. Acetylene for microscopic work has been commended

* *Zeit f. wiss. Mik.*, 1897.

† Science, 1901.

by the Canadian pathologist, Chas. H. Higgins.*

A New Method of Embedding Small Objects: GEORGE LEFEVRE, University of Missouri.

A special form of watch-glass was described which obviates the usual difficulties encountered in embedding loose, minute objects like echinoderm eggs.

The dish is a flat, solid watch-glass, containing a shallow concavity, in the bottom of which is molded a narrow, slot-like groove or trough.

The objects, after saturation with the solvent, are transferred to the dish, filled with melted paraffin and kept warm on the bath, by carefully dropping them from a pipette into the groove, where, owing to the confined space, they will remain closely massed. The bottom of the dish is then rapidly cooled on the surface of water, and the paraffin, when thoroughly hardened, may be removed without difficulty. The objects are held in the portion of the paraffin which previously filled the groove and which now projects from the surface of the block. The block is then attached to the paraffin-holder of the microtome, and the objects are ready for sectioning.

The practical usefulness of this dish has been thoroughly tested, and experience has shown that it may be manipulated so easily and conveniently that the embedding in it of such minute objects as it is intended for becomes as simple an operation as the embedding of larger ones which may be handled individually.

In addition to its use as described above, the dish is serviceable for the purpose of orientation. A small object lying in the groove may be rapidly oriented with a warm needle under the microscope and placed in any desired position. It is then possible to cool the paraffin without disturbing the object.

* *Acetylene Gas Journal*, 1901.

The Heredity of Sex: W. E. CASTLE, Harvard University. Presented by title. (Published in full in *Bulletin Mus. Comp. Zool., Harvard College.*)

1. Sex is an attribute of every egg and spermatozoon. It is independent of environment, and is inherited in accordance either with Mendel's law of heredity or with the principle of mosaic inheritance.

2. Mendel's law includes (*a*) the principle of *dominance* in the zygote of one of two alternative characters over the other, and (*b*) the principle of *segregation* of those characters at the formation of gametes.

3. In *mosaic* individuals alternative characters coexist without dominance of either; they pass together (*without segregation*) into the gametes.

4. Mendel's law governs the heredity of sex among dicœcious animals and plants; but hermaphroditic organisms are sex-mosaics, and form only mosaic gametes.

5. In dicœcious organisms, (*a*) one sex dominates, the other is latent; (*b*) each gamete bears the characters of one sex only, but can unite in fertilization only with a gamete bearing the characters of the *opposite* sex; (*c*) in the zygote sometimes the male character dominates, sometimes the female.

6. In parthenogenetic animals the female character invariably dominates over the male when both are present together. In such animals, (*a*) all fertilized eggs are female; (*b*) unfertilized eggs produced without segregation of sex-characters are female; (*c*) males develop only from unfertilized eggs *from which the female character has been eliminated.*

7. The female character eliminated from the male parthenogenetic egg passes into the testis; hence the spermatozoa of parthenogenetic animals are female (example, honey-bee).

8. Sex-characters segregate at the second (the 'reduction') maturation division. For eggs which develop without fertilization and without a second maturation division contain both the male and the female characters, the former recessive, the latter dominant. But, in normally parthenogenetic species, eggs which undergo a second maturation division and then develop without fertilization are always male. In such species the female character regularly passes from the egg into the second polar cell; in dicœcious animals *either* sex-character may remain in the egg.

Gilman A. Drew,
Secretary (Eastern Branch).
University of Maine.

SCIENTIFIC BOOKS.

Die Biogenhypothese. Eine kritisch-experimentelle Studie über die Vorgänge in der lebendigen Substanz. By Max Verworn. Jena, Gustav Fischer. 1903. 8vo. Pp. 114.

To consolidate the ideas which are presenting themselves more or less obtrusively to the minds of all workers in the biological sciences, and to give them concrete expression, is an accomplishment of no little importance, and it is this which Professor Verworn has attempted in propounding his Biogen-theory. Biogen is the special constituent of protoplasm whose decomposition and recomposition are the basis of the phenomena which we recognize as life, and the paper now under review is an examination into the nature of vital phenomena and an endeavor to deduce from this examination what the general composition and structure of the biogen molecules must be.

In its essence Verworn's theory differs but slightly from that advanced by Pflüger many years ago; it does differ, however, in its details. For it recognizes the similarity of the chemical processes taking place in the cell to those manifested during the action of an enzyme, accepting the prevalent view that an enzyme acts as a catalyzing agent and that the action of a catalyzer is the formation of a labile intermediate product which instantly decomposes, restoring the catalyzer to its original condition. Enzymes exist in the living substance which are capable of bringing about complicated syntheses and have the power of producing by their activity additional quantities of themselves; such phenomena demand the assumption that even in the molecules of the enzyme metabolism occurs and the biogen molecule may be regarded as something similar to such an enzyme.

Assuming this idea as a foundation, what may be predicated concerning the special composition of the biogen molecule? It is well known that an increase in the amount of oxygen increases, and a diminution of it diminishes, the irritability of the living substance, and Professor Verworn believes that it has been established by his own observations and those of his pupils on strychninized frogs that this phenomenon depends upon an increase in the lability of the biogen molecules in the presence of oxygen, and a diminution of it in the absence of that substance. If this be true, then it may be assumed that there is in the biogen molecule a chemical group which reacts readily with oxygen, and, since the functional activity of muscle, for instance, is associated, as Hermann demonstrated long ago, with the formation of non-nitrogenous products of decomposition, it may be supposed that the reacting group is a carbohydrate group, or, perhaps, on account of its affinity for oxygen, a carbon group of the type of a carbohydrate with a terminal aldehyde group.

But in addition there must also be a nitrogenous group in the molecule, since a continuous nitrogenous catabolism is going on in the tissues, and that this group is probably of the benzol type is shown by the formation of aromatic decomposition products, such as tyrosin, indol, phenol, skatol, etc., as the result of the digestion or putrefaction of albumen compounds. For the building up of a complicated organic compound a benzol group presents many possibilities, and Verworn supposes that such a group forms the center of a biogen molecule and that the carbohydrate